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What Makes Men Leak? An Investigation of Objective and Self-Report Measures of Urinary Incontinence Early After Radical Prostatectomy

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Aims: Pelvic floor muscle training for patients having radical prostatectomy promotes contraction of these muscles in anticipation of activities that may provoke urine leakage. The aims of this study were: to determine the contribution of the individual activities comprising a standardised 1-hour pad test (1HPT) to overall urine leakage early after radical prostatectomy; and to investigate relationships between the 1HPT, 24-hour pad test (24HPT) and the International Consultation on Incontinence Questionnaire—Short Form (ICIQ-SF) early after radical prostatectomy. **Methods:** A prospective analysis of patients having radical prostatectomy and receiving pelvic floor muscle training ($n = 33$). Participants completed the 1HPT, 24HPT and ICIQ-SF at 3 and 6 weeks postoperatively. Participants wore a separate, pre-weighed continence pad for each of the seven activities comprising the 1HPT; pads were weighed separately and together to calculate activity-related and overall urine leakage. **Results:** Walking at a comfortable speed and drinking while sitting were the two activities contributing most to overall urine leakage, albeit these activities also comprised 75% of 1HPT time. All component activities contributed a minimum $7 \pm 5\%$ of overall urine leakage. There were significant and strong to very strong correlations between all of the 1HPT, 24HPT, and ICIQ-SF at 3 weeks postoperatively. There were significant decreases in 24HPT ($P = 0.032$) and ICIQ-SF ($P = 0.001$) but no significant change in 1HPT from 3 to 6 weeks postoperatively. **Conclusions:** Pelvic floor muscle training should include contraction of these muscles in sedentary and walking postures. The 1HPT correlates well with the 24HPT, but may not be sensitive to early postoperative improvements in urinary leakage. *Neurourol. Urodynam. 35:225–229, 2016*. © 2014 Wiley Periodicals, Inc.

Key words: pelvic floor muscle training; prostatectomy; urinary incontinence

INTRODUCTION

Perioperative pelvic floor muscle training (PFMT) is an established conservative treatment for post-prostatectomy urinary incontinence (PPUI).[1] Several recent randomised trials have demonstrated reductions in the incidence and severity of early PPUI with PFMT,[2–4] and as such, it is recommended that all men undergoing radical prostatectomy receive PFMT.[5] Common to the intervention groups of the aforementioned randomised trials is that the PFMT was commenced preoperatively, and was described as functional, that is, patients were taught to contract the pelvic floor muscles in a range of positions (e.g., supine, sitting, standing), and/or while engaging in activities in daily living. The rationale for such preoperative, functional training is that patients will learn to contract the pelvic floor muscles in anticipation of activities that may provoke urine leakage.[6]

We would argue that to be truly functional, preoperative PFMT for men undergoing radical prostatectomy should be specifically targeted at those activities objectively demonstrated to result in postoperative urine leakage. Standard objective measures of urinary incontinence/leakage, for example, 1-hour and 24-hour pad tests (1HPT, 24HPT),[7] provide quantitative data on the overall degree/volume of urinary incontinence incurred in response to a series of defined (1HPT) or undefined (24HPT) activities of daily living, but do not differentiate between activities. Self-report measures of urinary incontinence, for example, the International Consultation on Incontinence Questionnaire—Short Form (ICIQ-SF),[8] do allow respondents to indicate (limited) circumstances that result in urine leakage, but the relevant data are rarely reported.

The primary aim of this analysis was to describe objectively those activities that result in urine leakage in patients early (3 and 6 weeks postoperatively) after radical prostatectomy; specifically to determine the relative contributions of the individual activities comprising a standardised 1HPT to overall 1HPT outcome.

Furthermore, studies of PFMT often report continence outcomes dichotomously (continent vs. incontinent) or categorically (continent vs. mild, moderate or severe incontinence) according to specific algorithms on the basis of either pad-tests or self-report measures.[1,3,4] Significant discrepancies between self-report and objective measures of urinary incontinence, and between the 1HPT and 24HPT, have previously been demonstrated in women with urinary incontinence,[9] and self-described continent men awaiting radical prostatectomy.[10] As a secondary aim, we sought to investigate relationships and agreement between continuous and categorical 1HPT, 24HPT, and ICIQ-SF data early after radical prostatectomy.

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PATIENTS AND METHODS

Data used in the current analysis were obtained during the conduct of a prospective, observational study of physical activity before and after radical prostatectomy.[11] The observational study was undertaken within one urological cancer centre in Western Sydney, Australia. Ethical approval was obtained from Western Sydney Local Health District Human Research Ethics Committee.

Patients

Between December 2011 and May 2012, patients having radical prostatectomy by one urological cancer surgeon (MIP), and attending physiotherapy for perioperative PFMT were invited to participate. Exclusion criteria included musculoskeletal, neurological and cardiovascular dysfunction precluding unaided mobility, and hence performance of a standardised 1HPT.

Methods

Participants undertook a standard program of perioperative physiotherapy, including PFMT and prescription of general physical activity, as previously described.[11] PFMT was commenced preoperatively, and included both supervised and independently performed contractions of the pelvic floor muscles in various functional positions; initial and ongoing feedback on contraction technique was provided using verbal and tactile cues, as well as real-time transabdominal ultrasound imaging. Subjective and objective measures of PPUI were obtained on the occasion of routine 3-week and 6-week postoperative physiotherapy appointments.

Self-report Measures of PPUI (Questionnaires)

1. The International Consultation on Incontinence Questionnaire—Short Form (ICIQ-SF).[8]

The ICIQ-SF consists of four questions. The first three questions relate to the frequency, amount and impact of urinary incontinence; responses are used to generate a summary score ranging from 0 to 21 points, with a higher summary indicating greater severity of urinary incontinence. The fourth question asks respondents to indicate when urine leaks from a list of activities, including when coughing or sneezing, and when physically active/exercising. Participants completed the ICIQ-SF without input from researchers or physiotherapists.

Objective Measures of PPUI (Pad Tests)

1. The 1-hour pad test (1HPT).[7]

The 1HPT was performed after completion of the ICIQ-SF. Participants were instructed to pass urine 1 hr before the start of the 1HPT and then to refrain from passing urine until the 1HPT had been completed. During the 1HPT participants undertook the following seven activities:

i) Drinking 500 mL of water, while sitting for 15 min;
ii) Walking on a treadmill at a self-determined comfortable speed for 30 min;
iii) Standing up and sitting down 10 times;
iv) Coughing 10 times in a standing position;
v) Running on the spot for 1 min;
vi) Bending down to pick up a coin from the floor 5 times; and
vii) Washing hands under running water for 1 min.

Participants wore a separate, pre-weighed continence pad for each activity, that is, changed pads between each activity. Pads were stored before and after use in airtight bags and reweighed using a calibrated scale with an accuracy of 0.1 g (UWGM1100G, Wedderburn, Sydney). Overall 1HPT outcome was calculated as the total weight gain of the seven pads worn. Severity of urinary incontinence during the IHPT was also categorised per the following standard algorithm: $\leq$1 g = continent; 1.1 to 9.9 g = mild incontinence; 10.0 to 49.9 g = moderate incontinence; $\geq$50.0 g = severe incontinence.[12]

2. The 24-hour pad test (24HPT).[7]

The 24HPT was performed over a 24-hour period commencing the morning preceding physiotherapy appointments (immediately after waking and passing urine). Participants were provided with a set of pre-weighed continence pads to be worn sequentially; used pads were placed in airtight bags and returned to the researchers for weighing. Overall 24HPT outcome was calculated as the total weight gain of all pads worn. Severity of urinary incontinence during the 24HPT was also categorised per the following algorithm: $\leq$4 g = continent; 4.1 to 19.9 g = mild incontinence; 20.0 to 74.9 g = moderate incontinence; $\geq$75.0 g = severe incontinence.[7,13]

Statistical Analysis

The statistical software package IBM SPSS Statistics Version 20 was used to analyse data. Paired t-tests were used to compare changes in measures of PPUI from 3 to 6 weeks postoperatively. Independent samples t-tests were used to compare outcomes for robotic-assisted laparoscopic prostatectomy (RALP) and open retropubic prostatectomy (ORP) participant groups. Simple descriptive statistics were used to describe the relative contributions of the individual activities comprising the 1HPT to overall 1HPT outcome. Spearman's rank order correlation coefficient was used to assess the presence and strength of associations between the three measures of PPUI (ICIQ-SF, 1HPT, 24HPT) at each of 3 and 6 weeks postoperatively, and between repeated measures of PPUI at 3 and 6 weeks postoperatively. Strength of positive correlation coefficients was described per Cohen,[14] that is, $0.30 \leq r_s \leq 0.49$ = moderate; $0.50 \leq r_s \leq 0.69$ = strong; $0.70 \leq r_s \leq 0.89$ = very strong. Two-tailed tests with a 5% significance level were used throughout. Unless otherwise stated, data are presented as mean $\pm$ SD.

RESULTS

Thirty-three patients (age: 62 $\pm$ 6 years, 24 RALP, 9 ORP participated in the study. Anthropometric and perioperative data and clinical characteristics are described elsewhere.[11] One participant did not attend a 3-week postoperative physiotherapy appointment, completing only the (home-based) 24HPT. Three-week postoperative data for a second participant was excluded from analysis, a postoperative urinary tract infection having resulted in a complete loss of urine control.

Table I presents continence outcomes for RALP and ORP participants, and all participants combined, at 3 and 6 weeks postoperatively. There were no significant differences between RALP and ORP participant groups for any continence outcome at 3 or 6 weeks postoperatively. There were significant decreases in 24HPT ($P = 0.032$) and ICIQ-SF ($P = 0.001$) from 3 to 6 weeks postoperatively for all participants, but no significant change in 1HPT ($P = 0.874$) from 3 to 6 weeks postoperatively.

Figure 1 shows the relative contributions (%) of the individual activities comprising the 1HPT to overall leakage during the

TABLE I. Continence Outcomes for RALP and ORP Participants, and All Participants Combined, at 3 and 6 Weeks Postoperatively

	1HPT (g)									
	Drinking	Walking	Sit-to-stand	Coughing	Running	Bending	Handwashing	Total	24HPT (g)	ICIQ-SF
3 weeks postoperative										
ORP	0.7 ± 0.4	5.6 ± 9.4	0.8 ± 0.9	1.6 ± 2.5	2.6 ± 6.5	0.5 ± 0.3	1.6 ± 3.5	13.4 ± 16.4	70.7 ± 78.3	8.9 ± 4.4
RALP	0.5 ± 0.2	2.6 ± 4.9	1.0 ± 2.7	0.5 ± 0.7	2.4 ± 7.5	0.4 ± 0.4	0.4 ± 0.6	7.8 ± 13.5	31.3 ± 47.0	7.3 ± 4.8
All participants	0.6 ± 0.3	3.5 ± 6.5	0.9 ± 2.3	0.8 ± 1.5	2.5 ± 7.2	0.4 ± 0.4	0.8 ± 1.9	9.4 ± 14.3	42.4 ± 59.0	7.8 ± 4.7
6 weeks postoperative										
ORP	0.4 ± 0.2	2.8 ± 5.0	0.3 ± 0.2	0.4 ± 0.2	0.4 ± 0.4	0.3 ± 0.2	0.2 ± 0.1	4.9 ± 5.3	26.2 ± 23.9	7.6 ± 3.3
RALP	0.5 ± 0.2	6.2 ± 18.4	0.5 ± 0.7	0.8 ± 2.1	1.2 ± 2.3	0.3 ± 0.5	1.0 ± 3.5	10.5 ± 19.2	29.7 ± 45.6	5.5 ± 4.3[a]
All participants	0.5 ± 0.2[1]	5.3 ± 15.9	0.4 ± 0.6	0.7 ± 1.8	1.0 ± 2.0	0.3 ± 0.5	0.8 ± 3.0	8.9 ± 16.7	28.8 ± 40.5[a]	6.0 ± 4.1[a]

[a]$P < 0.05$ versus 3 weeks.

1HPT at 3 and 6 weeks postoperatively. Walking was the primary contributor to overall leakage at both 3 weeks (39 ± 14%) and 6 weeks (39 ± 20%) postoperatively, and walking leakage was significantly and very strongly correlated with overall leakage at both 3 weeks ($r_s = 0.784$, $P < 0.001$) and 6 weeks ($r_s = 0.802$, $P < 0.001$) postoperatively. By virtue of the standardised 1HPT protocol, walking comprised 50% of overall 1HPT time.

Table II presents the responses to question 4 of the ICIQ-SF, that is, when does urine leak, at 3 and 6 weeks postoperatively. There was no significant change from 3 to 6 weeks postoperatively in the proportion of participants indicating leakage of urine with any of the listed activities/circumstances.

Correlations between the 1HPT, 24HPT and ICIQ-SF at each of 3 and 6 weeks postoperatively, and between repeated 1HPTs, 24HPTs and ICIQ-SFs at 3 and 6 weeks postoperatively, are presented in Table III. There were significant and strong to very strong correlations between all pairs of tested variables, excepting the 1HPT and ICIQ-SF at 6 weeks postoperatively (no significant correlation), and repeated 1HPTs at 3 and 6 weeks postoperatively (moderate correlation).

Table IV presents categorical severity of urinary incontinence on the 1HPT versus the 24HPT at 3 and 6 weeks postoperatively. At 3 weeks postoperatively, there was agreement between the 1HPT and 24HPT for 18/31 participants (58%). Of the remaining 13 participants, 9 (29%) recorded higher severity on the 24HPT and 4 (13%) recorded higher severity on the 1HPT. At 6 weeks postoperatively, there was agreement between the 1HPT and 24HPT for 22/33 participants (67%). Of the remaining 11 participants, 8 (24%) recorded higher severity on the 24HPT and 3 (9%) recorded higher severity on the 1HPT. Severity differed by >1 category (24HPT: severe; 1HPT: mild) for one (different) participant at each of 3 and 6 weeks postoperatively.

DISCUSSION

The current analysis provides novel data describing the relative contributions of specific physical activities to overall leaking of urine early after radical prostatectomy. All component activities of the 1HPT contributed a minimum 7 ± 5% of overall leakage. Walking on a treadmill and drinking while

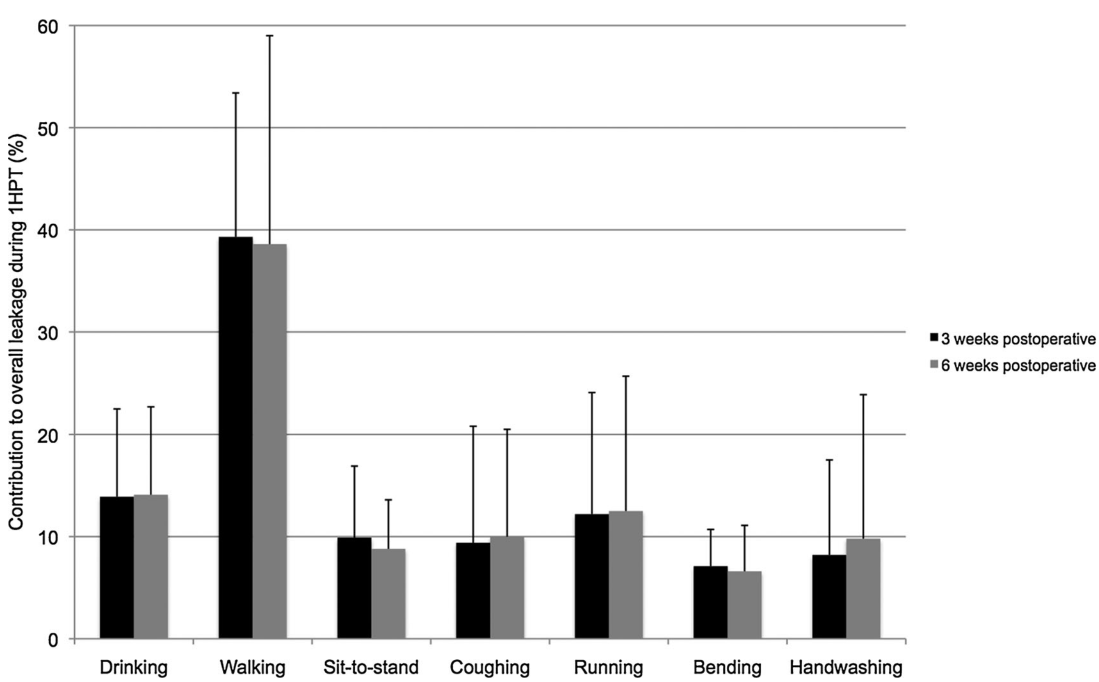

Fig. 1. The relative contributions (%) of the individual activities comprising the 1HPT to overall leakage during the 1HPT at 3 and 6 weeks postoperatively (mean ± SD).

TABLE II. Responses to Question 4 of the ICIQ-SF, That Is, When Does Urine Leak? at 3 and 6 Weeks Postoperatively

When does urine leak?	3 weeks postoperative	6 weeks postoperative
Never – urine does not leak	5/31 participants (16%)	7/33 participants (21%)
Leaks before you can get to the toilet	10/31 (32%)	8/33 (24%)
Leaks when you cough or sneeze	12/31 (39%)	13/33 (39%)
Leaks when you are asleep	5/31 (16%)	3/33 (9%)
Leaks when you are physically active/exercising	10/31 (32%)	11/33 (33%)
Leaks when you have finished urinating and are dressed	7/31 (23%)	2/33 (6%)
Leaks for no obvious reason	9/31 (29%)	9/33 (27%)
Leaks all the time	0/31 (0%)	0/33 (0%)

sitting were the two components of the 1HPT providing the largest contribution (3 weeks postoperatively: $53 \pm 16\%$; 6 weeks postoperatively: $53 \pm 21\%$) to overall 1HPT outcome. It is noted, however, that walking and drinking together comprised 45 min (75%) of the 1HPT.

Our results hold practical implication for clinicians providing PFMT. Recommendations for preoperative PFMT include that patients should practice contracting the pelvic floor muscles in many different positions and activities—particularly those when the intra-abdominal pressure rises.[6] The stated aim of said practice is to develop the ability to contract the pelvic floor for known leakage-provoking events. Our 1HPT findings support that leakage-provoking events vary considerably between patients, and that even sedentary activities may provoke a significant proportion of overall leakage. Furthermore, when patients were asked to indicate (via the ICIQ-SF) the activities that cause leakage, 27–29% reported leaking for no obvious reason. This sedentary and/or inexplicable leakage may be insidious when compared to that associated with a cough, or running, but also requires early therapeutic consideration.

We chose to investigate urine leakage during the standardised 1HPT because of its clinical convenience, and its described intention of approximating the circumstances of everyday life. One criticism of the 1HPT specific to patients having radical prostatectomy is that, as urine leakage occurs predominantly later in the day,[6] 1HPTs conducted earlier in the day may underestimate severity. We did not specifically control for time of day in the current analysis, but all 1HPTs were conducted before 5:00 p.m., and the majority were conducted before midday. Perhaps accordingly, we found more patients with a higher severity rating on the 24HPT than the 1HPT than vice versa (3 weeks postoperative: 9 vs. 4; 6 weeks postoperative: 8 vs. 3). That a majority of patients had equivalent severity ratings on both the 1HPT and 24HPT, and that there were significant correlations between the 1HPT and 24HPT, suggests that the 1HPT is a reasonable proxy for the 24HPT early after radical prostatectomy. Consistently strong correlations between the 24HPT and ICIQ-SF suggest, however, that the 24HPT (should it be clinically feasible) may provide a more consistent objective indication of urine leakage and burden than the 1HPT, which did not correlate significantly with the ICIQ-SF at 6 weeks postoperatively.

Also of interest, whereas urine leakage as measured by the 24HPT and ICIQ-SF improved from 3 to 6 weeks postoperatively, urine leakage as measured with the 1HPT did not. Recovery of continence after radical prostatectomy is known to be a function of postoperative time,[12] suggesting a second limitation of the 1HPT, that is, it is not sensitive to early changes in continence status. An intriguing alternative theory is that patients may improve more on the 24HPT and ICIQ-SF because they (patients) have learnt to regulate their activity to minimise leakage. The 1HPT, being externally-imposed, allows no such self-regulation, save perhaps in relation to the strenuousness with which the component activities are undertaken (e.g., treadmill walking speed).

Limitations of the Study

We did not investigate activities other than those described in the standardised 1HPT.[7] Nor did we randomise the order of the component activities of the 1HPT, and therefore we cannot exclude an order effect. It is conceivable that patients may have had greater bladder filling for the latter component activities (>30 min after drinking 500 mL), and may therefore have been at greater risk of urine leakage. Moreover, the component activities of the 1HPT have different durations, so the relative risk of leakage during 1 min of running on the spot cannot be directly compared to 1 min of walking. Another limitation of the study is that we did not standardise the time of day for 1HPTs for our study cohort, nor for individual patients. This lack of standardisation may have contributed to the relatively weak correlation between 3-week and 6-week postoperative 1HPTs, when compared to those observed with the 24HPT and ICIQ-SF. As noted, it is also possible that participants may have undertaken the 1HPT with greater (or indeed lesser) strenuousness at 6 weeks than 3 weeks postoperatively; unfortunately

TABLE III. Correlations Between the 1HPT, 24HPT and ICIQ-SF at Each of 3 and 6 Weeks Postoperatively, and Between Repeated 1HPTs, 24HPTs and ICIQ-SFs at 3 and 6 Weeks Postoperatively

	1HPT versus 24HPT	1HPT versus ICIQ-SF	24HPT versus ICIQ-SF
3 weeks postoperative	$r_s = 0.674$, $P < 0.001$	$r_s = 0.592$, $P < 0.001$	$r_s = 0.664$, $P < 0.001$
6 weeks postoperative	$r_s = 0.535$, $P < 0.001$	$r_s = 0.156$, $P = 0.386$	$r_s = 0.675$, $P < 0.001$
	1HPT	24HPT	ICIQ-SF
3 versus 6 weeks postoperative	$r_s = 0.375$, $P = 0.038$	$r_s = 0.736$, $P < 0.001$	$r_s = 0.854$, $P < 0.001$

TABLE IV. Categorical Severity of Urinary Incontinence on the 1HPT Versus the 24HPT at 3 and 6 Weeks Postoperatively

	3 weeks postoperative (n = 31)				6 weeks postoperative (n = 33)			
	24HPT category				24HPT category			
1HPT category	Continent	Mild	Moderate	Severe	Continent	Mild	Moderate	Severe
Continent	0	0	0	0	0	1	0	0
Mild	1	14	6	1	1	19	4	1
Moderate	0	3	2	2	0	1	2	2
Severe	0	0	0	2	0	0	1	1

we did not collect, for example, treadmill walking distance data with which to gauge this.

Finally, our patients had low overall urine leakage/burden compared to other post-radical prostatectomy populations.[3,12] As such, objectively small amounts of leakage during a single activity of the 1HPT might represent a large proportion of a small overall 1HPT outcome, thus providing a false impression of activity-related leakage.

CONCLUSIONS

Perioperative PFMT often focuses on contracting the pelvic floor during activities increasing intraabdominal pressure, hence presumed to provoke urine leakage. We have shown that the majority of urine leakage (during the 1HPT) early after radical prostatectomy actually occurs while sitting and walking at a comfortable speed. Functional PFMT should therefore also address sustained contraction of the pelvic floor muscles in sedentary and walking postures. The standardised 1HPT correlates strongly with the 24HPT and ICIQ-SF at 3 weeks after radial prostatectomy, but is not sensitive to early improvements in continence status. The 1HPT, and/or its specific components, might therefore best be used as a guide to therapeutic intervention, rather than a measure of therapeutic effect.

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